ISR Journal of Medical Case Reports (ISRJMCR)
Homepage: https://isrpublisher.com/isrjmcr/
Volume 01, Issue 07, November 2025 ISSN: 3107-5576 (Online)

Artificial Intelligence-Assisted Evaluation of Platelet-Rich Plasma Therapy in a Refractory Chronic Lower Leg Wound: A Case Report

Azzouzi Mohamed Salim[1]*, Amine Hajjar[1], Oumkaltoum Elatiqi[1], Samira Boukind[2], Moulay Driss Elamrani[2], Yassine Benchamkha[1]

[1]Department of Plastic and Reconstructive Surgery, Mohammed VI University Hospital, Marrakesh, Morocco
[2]Departement of Anatomy, Faculty of Medicine of Marrakech, Morocco

***Corresponding author:** Azzouzi Mohamed Salim
Department of Plastic and Reconstructive Surgery, Mohammed VI University Hospital, Marrakesh, Morocco

Article History
Received: 05-10-2025
Accepted: 23-11-2025
Published: 28-11-2025

Abstract: **Case Report**

Introduction: Chronic lower limb wounds remain a therapeutic challenge. Platelet-rich plasma (PRP) has emerged as a regenerative adjuvant, yet objective evidence of its efficacy in stagnant wounds is often lacking. ***Case Report***: We report a 46-year-old patient with a traumatic lower leg wound evolving for over three years. Despite a 4-week run-in period of optimized wound bed preparation, the lesion remained stagnant with no significant reduction in surface area. PRP therapy was subsequently introduced. ***Methods***: Digital planimetry and tissue composition were quantified using a calibrated deep-learning segmentation model. ***Results***: Following the run-in period (standard care), the wound area decreased by only 5%. Four weeks post-PRP injection, an 85% reduction in wound surface was observed, accompanied by a shift from fibrin-dominant to granulation-dominant tissue. ***Conclusion***: PRP therapy effectively reactivated the healing cascade in a wound refractory to standard care. AI-assisted monitoring provided precise, calibrated data confirming the specific efficacy of the biological intervention.

Keywords: Chronic wound, Platelet-rich plasma, Computer-assisted planimetry, Wound healing, Regenerative medicine.

INTRODUCTION

Chronic lower extremity wounds represent a significant burden in reconstructive surgery. Impaired angiogenesis, persistent inflammation, and growth factor deficiency often lead to a "stalled" healing state [1].

Platelet-rich plasma (PRP) is defined as an autologous preparation of plasma with a platelet concentration significantly higher than baseline (typically 3-5 times). Upon activation, platelets release high concentrations of alpha-granule-derived growth factors, including Platelet-Derived Growth Factor (PDGF), Transforming Growth Factor-beta (TGF-β), and Vascular Endothelial Growth Factor (VEGF). These cytokines play a pivotal role in shifting the wound environment from a chronic inflammatory state to a proliferative phase by stimulating angiogenesis, collagen synthesis, and re-epithelialization [2, 3].

While standard of care (SOC) aims to optimize the local environment through debridement and moisture-balanced dressings, it is often insufficient for recalcitrant lesions. This report utilizes calibrated AI-assisted image analysis to objectively quantify the specific impact of PRP on a stagnant chronic wound.

Case Presentation

A 46-year-old patient presented with a chronic lower leg wound following a road traffic accident three years prior. Medical evaluation excluded significant comorbidities including diabetes mellitus, smoking history, and peripheral arterial disease. Lower limb arteriography confirmed normal vascular circulation, ruling out ischemic etiology.

Standard Care Phase (Run-in Period)

At initial consultation on July 2, 2025, physical examination revealed two adjacent ulcerative lesions with extensive fibrin deposition and poor granulation tissue formation. A strict protocol of optimized wound bed preparation was implemented, consisting of:

- Gentle enzymatic and mechanical debridement
- Moisture-balanced hydrocolloid dressings
- Weekly wound assessment and dressing changes
- Protection from mechanical trauma

Despite adherence to this evidence-based regimen for 4 weeks, re-evaluation on July 31, 2025, demonstrated minimal clinical improvement with persistent fibrin coverage and negligible surface area reduction. This lack of response confirmed the refractory nature of the wound, prompting the decision to introduce PRP therapy on August 1, 2025.

Methods

PRP Preparation Protocol

To ensure reproducibility and standardization, PRP was prepared using a validated single-spin centrifugation protocol:

1. 20 mL of autologous venous blood was collected in citrate-dextrose anticoagulant tubes (ACD-A).
2. The blood was centrifuged at 1500g for 10 minutes at room temperature.
3. The supernatant platelet-poor plasma layer was carefully discarded.
4. The buffy coat layer (containing concentrated platelets and leukocytes) was resuspended with the remaining plasma.
5. Final volume: 4 mL of Leukocyte-Rich PRP (L-PRP).
6. Platelet concentration: 3-4 times above baseline (confirmed by hematological analysis).

The PRP was administered under sterile conditions via peri-lesional injection (0.2 mL/cm² of wound perimeter) followed by topical application of the remaining volume directly onto the wound bed. No additional activating agents were used. The procedure was well tolerated without adverse effects.

AI-Assisted Wound Assessment

Standardized digital photographs were obtained at each evaluation point using consistent methodology:

- Camera: iPhone 12 Pro with automatic white balance disabled.
- Positioning: Perpendicular to wound surface at fixed 30 cm distance.
- Lighting: Consistent LED illumination (5500K color temperature).
- Calibration: Sterile centimeter ruler placed adjacent to wound for scale reference.
- Timing: All images captured immediately after wound cleansing.

Image analysis was performed using ImageJ software (NIH, USA) integrated with a U-Net Convolutional Neural Network (CNN) architecture trained specifically for wound tissue segmentation. The deep learning model was capable of:

- Automated wound boundary detection.
- Pixel-level classification of tissue types (granulation tissue vs. fibrin/slough).
- Precise surface area calculation in cm² based on calibration marker.
- Percentage quantification of each tissue component.

All AI-generated segmentations were validated by a senior wound care clinician to eliminate potential artifacts and ensure clinical accuracy.

RESULTS

Quantitative wound analysis demonstrated a clear temporal relationship between treatment phases and healing dynamics.

Table 1: Quantitative wound evolution across treatment phases

Time Point	Duration	Wound Area	Area Reduction	Granulation	Fibrin	Clinical Status
	(Days)	**(cm²)**	**(%)**	**(%)**	**(%)**	
Baseline	0	12.5	-	45	55	Initial consult
Pre-PRP	29	11.9	-4.8	50	50	Stagnation despite SOC
Post-PRP	57	1.8	-85.6	95	5	Rapid healing

Phase 1: Standard Care (Days 0-29)

During the initial 4-week period of optimized wound bed preparation, wound surface area decreased marginally from 12.5 cm² to 11.9 cm², representing only a 4.8% reduction. Tissue composition showed minimal improvement, with granulation tissue increasing from 45% to 50% and persistent fibrin coverage at 50%. This plateau confirmed the wound's refractory status.

Phase 2: Post-PRP Intervention (Days 30-57)

Following PRP administration, wound healing dynamics changed dramatically. Over the subsequent 4-week period, wound surface area decreased from 11.9 cm² to 1.8 cm², achieving an 85.6% reduction. Tissue composition shifted significantly, with granulation tissue increasing to 95% and fibrin coverage decreasing to only 5%. Clinical examination revealed healthy pink granulation tissue with active epithelialization from wound margins.

Figure 1: Initial wound appearance (July 2, 2025) with fibrinous ulcerative lesions

Figure 2: Pre-PRP wound status (July 31, 2025) showing improved granulation

Figure 3: Post-PRP follow-up demonstrating advanced granulation and epithelialization

Figure 4: The wound demonstrated progressive contraction, high-quality granulation tissue, and active epithelialization, indicating successful transition from a chronic inflammatory state to an effective regenerative healing phase

DISCUSSION

This case report provides objective evidence for the therapeutic efficacy of PRP in a chronic wound that failed to respond to standard care. The critical inclusion of a documented run-in period under optimized wound management serves two important purposes: first, it confirms that the wound was truly refractory rather than simply undertreated; second, it establishes a clear temporal baseline against which to measure PRP-specific effects.

Comparison with Current Evidence

Our findings align with recent high-level evidence supporting PRP efficacy in venous and chronic ulcers. A comprehensive meta-analysis by Li *et al.*, (2024) evaluating randomized controlled trials concluded that PRP significantly increases complete healing rates (relative risk 2.72) compared to standard care alone [4]. Similarly, Chen *et al.*, (2024) demonstrated that PRP combined with advanced wound therapies shortens healing time by promoting angiogenesis and reducing inflammatory mediators in refractory wounds [5].

However, clinical outcomes in the literature often vary substantially due to heterogeneity in PRP preparation protocols. Studies using different centrifugation speeds, spin cycles, and activation methods produce PRP products with widely varying platelet concentrations and growth factor profiles [6]. This lack of standardization has been identified as a major barrier to clinical translation and evidence synthesis.

In this case, the use of a rigorously standardized single-spin protocol (1500g, 10 minutes) ensured a consistent therapeutic dose of platelets (3-4× baseline concentration), likely contributing to the rapid reversal of the healing plateau observed during the run-in period.

Role of AI-Assisted Monitoring

Traditional wound assessment relies on subjective clinical judgment or manual planimetry using rulers, both of which are prone to inter-observer variability and measurement error. The integration of calibrated AI-based image segmentation in this case provided several advantages:

- **Objectivity:** Automated tissue classification eliminates observer bias
- **Precision:** Pixel-level analysis provides accurate surface area measurements (±0.1 cm^2)
- **Reproducibility:** Standardized imaging protocol ensures consistent data across time points
- **Clinical validation:** Expert review of AI segmentation prevents algorithmic artifacts

This methodology represents a significant advancement over subjective wound photography and supports the emerging role of AI as a clinical decision support tool in wound care [7].

Biological Mechanisms

The observed shift from a fibrin-dominant to granulation-dominant wound bed following PRP administration likely reflects the multifactorial biological activity of platelet-derived growth factors. PDGF promotes fibroblast migration and proliferation, TGF-β stimulates collagen synthesis and extracellular matrix remodeling, while VEGF induces angiogenesis and microvascular perfusion [2, 3]. This coordinated biological response effectively "reboots" the stalled healing cascade characteristic of chronic wounds.

LIMITATIONS

This single-case report has inherent limitations. The absence of a randomized control group prevents definitive causal inference, and individual patient variability limits generalizability. While the temporal association between PRP administration and accelerated healing is suggestive, we cannot entirely exclude the contribution of delayed response to standard care, though the 4-week stagnation period makes this unlikely.

Future prospective studies with larger sample sizes, control groups, and longer follow-up periods are necessary to confirm these findings and establish optimal PRP protocols for specific wound etiologies.

CONCLUSION

This case demonstrates that PRP therapy can successfully reactivate the healing cascade in a chronic traumatic wound that failed to respond to 4 weeks of optimized standard care. The dramatic acceleration in wound closure (from 4.8% to 85.6% reduction) following PRP intervention suggests a direct therapeutic effect beyond spontaneous healing.

The integration of standardized PRP preparation protocols with objective AI-assisted wound monitoring represents a promising methodological framework for future regenerative medicine studies. This approach addresses two critical gaps in current wound care research: treatment standardization and objective outcome assessment.

PRP should be considered as a viable therapeutic option for refractory chronic wounds when standard care proves insufficient, particularly when combined with rigorous monitoring protocols to document treatment response.

REFERENCES

1. Frykberg, R. G., & Banks, J. (2015). Challenges in the treatment of chronic wounds. *Adv Wound Care*, *4*(9), 560-582.
2. Pineda-Cortel, M. R, *et al.*, (2024). Complexity of platelet-rich plasma: mechanism of action and clinical applications in tissue regeneration. *J Surg Res*, *45*(3), 234-248.
3. Cozma, C. N, *et al.*, (2023). Platelet-rich plasma: mechanism of action and clinical applications in wound healing. *Rom J Morphol Embryol*, *64*(2), 157-165.
4. Li, Y, Wang, C, Zhang, M, *et al.*, (2024). Efficacy and safety of allogeneic platelet-rich plasma in chronic wound treatment: a systematic review and meta-analysis. *Sci Rep*, 14, 24150.
5. Chen, H., Xu, T. J., Yu, H., Zhu, J. L., Liu, Y., & Yang, L. P. (2024). RETRACTED: Effect of platelet-rich plasma combined with negative pressure wound therapy in treating patients with chronic wounds: A meta-analysis. *International Wound Journal*, *21*(4), e14758.
6. Everts, P. A, *et al.*, (2021). Platelet-rich plasma: new insights for cutaneous wound healing management. *Regen Med*, *16*(8), 765-782.
7. Wang, C., Anisuzzaman, D. M., Williamson, V., Dhar, M. K., Rostami, B., Niezgoda, J., ... & Yu, Z. (2020). Fully automatic wound segmentation with deep convolutional neural networks. *Scientific reports*, *10*(1), 21897.